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Noise map: professional versus crowdsourced data

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Abstract

The goal of the recent study is to evaluate the usability of the data measurement capability of an average smartphone and make a comparative study on available open source mobile applications potentially suitable to noise mapping. In the study a dataset generated by professional equipment was used as a reference. The study confirmed that the mobile applications running on the smartphones tested are not capable for scientific measurement although correlation suggest that calibration may lead to reasonably accurate noise level capture. The study also revealed that different mobile applications produce different outputs. These type of user generated noise measurements cannot substitute professional surveys but can contribute to noise monitoring to testing the effect of the action plans created by the settlements in order to reduce noise pollutions.
Keywords: noise mapping, crowdsourcing.

1 Introduction

Noise pollution is one of the main and growing environmental problems in urban areas. It affects everyday life, well-being and it can even cause severe psychological problems.
According to the Environmental Noise Directive of the European Union 2002/49/EG article 7, agglomerations with a population more than 250 000 should create a noise map.

The Hungarian Government Decree 280/2004. (X.20) in 2004 obliged all settlements to comply with the Directive. The Decree also requires to renew these maps every five years, however due to the lack of financial resources local authorities are unable to fund the renewal of these maps.

An alternative to update the noise maps is crowdsourced data collection. Due to increased availability of location-enabled smart phones with a range of digital sensors including sound recording, this kind of data acquisition is promising.

However it is important to assess the accuracy of surveys carried out by mobile equipment. In this preliminary study we investigated 2 aspects of crowdsourcing noise data collection.

2 Method

We investigated 2 basic phenomenon of noise level survey carried out by commercial smartphones to assess the possibility of crowdsourced noise measurement: (1) we compared the measurements of a professional equipment and a smartphone. (2) We compared the measurements of 2 different mobile applications running on the same model of smartphones.

The standard weighting used in noise measurement is A-Weighting (LA) which applies a frequency dependent weighting on the noise levels according to human perception. A-weighted measurements are expressed as dBA or dB(A).

2.1 Comparing the professional equipment and smartphone

The professional survey was carried out in 2012 in Székesfehérvár by a Brüel & Kjaer sound level meter type 2250 (Class 1) equipment.

We carried out the smartphone survey a year later by Sony Xperia P mobile phones and Sound Meter PRO onboard mobile application. As we had no access to the professional equipment, we repeated the survey when the conditions were the most similar, on the same calendar day of the following year. Both dates fall on a weekday so presumably the traffic conditions were similar and there was no change in the state of other objects responsible for noise emission.

The measurements in the 2 surveys were carried out in the same period of the day averaging 15 seconds of measurement at 51 locations mainly in the inner part of the city. The recorded parameters were (1) lowest time-weighted sound level – LAFmin, (2) higher time-weighted sound level – LAFmax and (3) average sound level – LAeq.

2.2 Comparing different mobile applications

We compared (1) Sound Meter PRO (Smart Tools co.) and (2) Noise meter (JINASYS) mobile applications running on the same models (Sony Xperia P) at the same time and location.

1 minute continuous measurements were averaged starting at 6:00, 11:00, 14:00, 17:00, and 21:00 and repeated 7 times with 10 minutes delays producing 35 parallel measurements. Therefore peak hours and more quiet hours were also

included. The data was recorded at 7-8 m from the axis of the traffic line at the busiest intersection in Gyula, Hungary.

3 Results

There are significant correlations between the professional equipment and the mobile phone measurements in case of LAFmax (p=0.0041) and LAeq (p= 0.0038) but the correlation is not significant in case of LAFmin (p= 0.349963942). The correlation coefficients of LAFmax (r= 0.39) and LAeq (r= 0.40) suggest that there are probable positive correlations between the professional and mobile equipment measurements.
Comparing the results of the professional and mobile phone measurements, the latter produced higher values of dB.

There are also significant correlations between the 2 different mobile application measurements in case of LAmin (p=8.3E-09) and LAeq (p= 0.0097) but not in case of LAmax (p= 0.075). The correlation coefficients of LAmin (r= 0.79) and LAeq (r= 0.43) suggest that there are probable positive correlations between the measurements of the 2 mobile applications. The deviation between the values were approximately 10-15 dB.

4 Conclusions

The mobile application running on the smartphone is not capable for professional survey, however significance of correlations of LAFmax and LAeq suggests that at least change detection is possible which can provide additional data for strategic noise monitoring to test the effect of the action plans created by the settlements in order to reduce noise pollutions.

The higher values of the professional equipment is most likely due to the lack of calibration and the characteristic of the sensors. In a further survey calibration can be tested.

The study also revealed that different mobile applications produce different outputs. As the same sensors were used the difference is probably due to the difference in the calculations by the applications.

The mobile applications retrieve a recorded sample from the microphone. The application can calculate the sound level values from the sample only. Depending on the functions the applications calculates the noise levels from the sound sample, the values may be different. There are many applications available but the second finding suggests that in a crowdsourced survey the same application have to be used by all surveyors.